MORPHOLOGY AND PATHOMORPHOLOGY

THE RELATIONSHIP OF CELLS AND CAPILLARIES OF THE NUCLEI OF THE TRIGEMINAL NERVE IN THE POSTNATAL PERIOD OF DEVELOPMENT

E. G. Balashova

From the Laboratory for Study of the Development of the Brain (Director-Corresponding Member of the Acad. Med. Sci. USSR B. N. Klesovsky) Institute of Pediatrics (Director-Corresponding Member of the Acad. Med. Sci. Prof. O. D. Sokolova-Ponomareva) Acad. Med. Sci. USSR, Moscow

(Received June 20, 1955. Presented by Acting Member of the Acad. Med. Sci. USSR G. N. Speransky)

According to V. N. Klesovsky [1], the nerve cells of the cerebral hemispheres and the sources of their nutrition — the cerebrospinal fluid and blood transport systems — stand in close relationship to one another. In the early stages of intrauterine development of the cerebral hemispheres, the basic source of nutrition of the nerve tissue is the cerebrospinal fluid. In this period, the embryonic nerve cells are situated at the ventricular surface of the brain, i.e., immediately adjacent to the source of nutrition. As the cerebral hemispheres develop, the vascular network starts to function, and cerebrospinal nutrition of the nerve cells of the cortex of the hemispheres is replaced with cerebrospinal fluid-blood nutrition. With increase in the number of cells, and the increase in them of the rate of metabolic processes, the cells are shifted from the maternal layer on the surface of the brain to the soft brain membrane rich in blood vessels. In this part of the wall of the hemispheres, where the migratory nerve cells are concentrated, while formation of the cortex is in progress, the vascular network is formed which already in a 3-month human fetus is strongly developed and becomes the predominant source of nutrition of the nerve cells.

However, the process of development of the nerve tissue does not end in the embryonic period. After birth, there takes place further maturing of the nerve and glialome cells of the conducting paths and receptors. Thus, for example, according to O. V. Beloborodova, myelination of the peripheral nerves, not only of the auditory, but also of the vestibule analyzers, is completed within only about 2 months of postnatal development. The brain mass increases. T. P. Zhukova notes that the largest growth in the brain weight in kittens takes place in the first months of life. At about three months, the weight of the brain of an adult animal is reached. The blood transport system also changes. Thus, according to E. V. Kapustina, development of the vascular network in the soft brain membrane of kittens continues up to 3 months of postnatal life. In the brain substance itself, as Z. N. Kiseleva points out, new growth of the capillaries in certain regions of the cortex takes place in kittens up to 4 months. In line with the works of E. V. Kapustina and Z. N. Kiseleva, it was noted by T. P. Zhukova (1954) that the amount of blood characteristic of the brain of an animal becomes established after only about 2-3 months of extrauterine life.

In connection with these findings, there arises the question as to how the regeneration of the vascular network and growth of the brain matter after birth influence the forms of mutual relations between the nerve cells and the surrounding capillaries developing in the embryonic period of development.

So far, the relationship of the nerve cells and capillaries has been studied only in adult animals. B. N. Klesovsky, E. N. Kosmanakaya and E. G. Balashova [2] established that the link between these components in adult animals is different in different parts of the central nervous system.
In this work we shall consider the processes of formation of this link between the nerve cells as the basic structure of the nerve tissue and the source of their nutrition - by the capillary network in the postnatal period of development. The relation of the nerve cells and the capillaries has been investigated in the nuclei of the trigeminal nerve. The system of the trigeminal nerve is one of the first to engage in brisk activity from the moment of birth of the animal. This enabled us to trace the emergence of the relationship of the nerve cells and the capillaries and also the development of the vascular network in relation to the maturation of the nerve cells.

The investigation was conducted on 91 cats. We treated the brain of animals of different ages. For the purpose of studying the development of the vascular network, the brain in 42 cats was impregnated with silver according to the method of Klosovsky. The vascular network of the brain of 49 animals was injected with India ink in gelatin. The preparations obtained were stained according to the method of Nissl.

On comparing the relationship of the nerve cells and surrounding capillaries in newborn kittens and adult animals, we noted a big difference in the number of cells not in contact with the capillaries. In all the nuclei of the trigeminal nerve, i.e., in the motor and sensory nuclei and the nucleus of the root of the spinal nerve of the newborn kittens, the number of cells not in contact with the capillaries was considerably higher than in the same nuclei of adult animals. Thus, in the motor nucleus of the newborn kittens, to each 10 cells adjacent to the capillaries, there were 13 cells not in contact with them (see table). At the same time, in the adult cats, to each 10 cells in contact with the capillaries, there were altogether 6 cells separate from the capillaries. The same relationship exists in the sensory nuclei. For example, in a sensory nucleus of the newborn kittens, to each 10 cells in contact with the capillaries, there were 46 cells not in contact with them, and in the adult animals only 20 cells.

### Growth Changes in Relation of Nerve Cells and Capillaries and Density of the Vascular Network in the Nuclei of the Trigeminal Nerve in Cats

<table>
<thead>
<tr>
<th>Age of animal</th>
<th>Motor Nucleus</th>
<th>Sensory Nucleus</th>
<th>Nucleus of spinal root</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Density of vascular network in volume 50x50x x210 μ³ tissue</td>
<td>Number of cells separate from capillaries to ten cells with capillaries adjacent to them</td>
<td>Density of vascular network in volume 50x50x x210 μ³ tissue</td>
</tr>
<tr>
<td>Newborn</td>
<td>13</td>
<td>10 : 13</td>
<td>15</td>
</tr>
<tr>
<td>Ten days</td>
<td>14</td>
<td>10 : 7</td>
<td>17</td>
</tr>
<tr>
<td>1 month</td>
<td>15</td>
<td>10 : 5</td>
<td>18</td>
</tr>
<tr>
<td>2 months</td>
<td>12</td>
<td>10 : 7</td>
<td>15</td>
</tr>
<tr>
<td>Fully grown animal</td>
<td>14</td>
<td>10 : 6</td>
<td>16</td>
</tr>
</tbody>
</table>

The above figures show that in the nuclei of the trigeminal nerve in the postnatal period of development the nerve cells and capillaries approach each other (Fig. 1).

Later we tried to establish those regenerations in the brain tissue, due to which the nerve cells and capillaries draw together. Upon investigations of the vascular network in the nuclei of the trigeminal nerve, a difference in its density in animals of different ages was noted. Thus, while in the motor nucleus in the newborn cats to a given volume of brain tissue there were 13 capillaries, in 10 day old cats in the same volume of tissue already 14 capillaries were counted (see table). The increase in the density of the vascular network also occurs in the sensory nuclei. During ten days of life of the kittens in the investigated volume of tissue of the sensory nucleus, the density of the vascular network increased by two capillaries. Later the number of capillaries continued to grow and reached the maximum in one-month-old kittens. At this age, to the same volume of tissue in the motor nucleus there were 15 capillaries and in the sensory nucleus 18. Increase in the density...