ASSOCIATION FIBERS OF CORTICAL REPRESENTATION ZONES 1 AND 2 OF THE SPLANCHNIC NERVE IN THE CAT

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Studies of interneuronal relationships in the zones of cortical representation of the splanchnic nerve have revealed the presence of anatomical connections between these zones and the motor, premotor, and limbic areas of the cortex [1].

In the present research we used the method of axon degeneration to determine the intercommunications between zones 1 and 2 of the representation of the splanchnic nerve.

EXPERIMENTAL METHOD

The investigation was conducted on 20 adult cats. Three types of operation were performed. Extirpation of areas of the cortex in one group of animals simply revealed the presence of association fibers and, in order to discover their nature, in the remaining two groups of animals the association fibers in the white matter and in the cortex were injured separately. In one group of animals the white matter was "undercut" and in the other group only the cortex of the projection zones was cut down to the required depth. By "undercutting" it was possible to observe degeneration of the radial fibers, i.e., of the association fibers composing the Y-shaped and intralobular fibers. Incision of the cortex to the required depth revealed degeneration of the horizontal intracortical fibers.

The localization of the cortical projection zones of the splanchnic nerve was determined from topographical data obtained by the method of primary responses [2, 3]. Zone 1 is situated in the region of the gyrus ansatus and zone 2 in the anterior portion of the gyrus ectosylvius anterior. According to the chart of Gurevich and Bykhovskaya, zone 1 corresponds to the middle divisions of cortical Areas 1 and 2, and zone 2 to the most anterior portions of Area 50.

These operations were performed after the preliminary division of the soft tissues of the head, the drilling of burr holes in the corresponding areas of the skull, and incision of the dura. Aseptic precautions were observed during operation. The white matter was "undercut" by means of an angled leucotomy knife. To prevent injury to the cortical layers, the knife was introduced into the brain in areas remote from the projection zones of the splanchnic nerve. In operations on zone 1, the leucotomy knife was inserted into the cortex in the region of Area 7, and in operations on zone 2, in the region of Area 22 (according to Gurevich and Bykhovskaya's chart).

The cortex was excised by means of a scalpel through a circular incision. The animals were sacrificed between 5 and 9 days after operation. The material was impregnated by Nauta's method, after preliminary perfusion of the brain with 10% neutral formalin solution. In each experiment the cortex of the surviving projection zone of the splanchnic nerve in the operated hemisphere was investigated.

EXPERIMENTAL RESULTS

Cortex of projection zone 1 of the splanchnic nerve. After extirpation of the area of the cortex corresponding to projection zone 2 of the splanchnic nerve, a few thin denervated fibers were found in sections of the cortex of zone 1. These were mainly radial fibers lying in the inferior layers of the cortex. However, individual degenerated horizontal fibers were also found. The changes observed were in the form of severe fragmentation, although the radial orientation was maintained. Besides these irreversible changes, highly argentophilic convoluted fibers with varicose thickenings. Various stages of degeneration of the thin fibers are illustrated in Fig. 1.

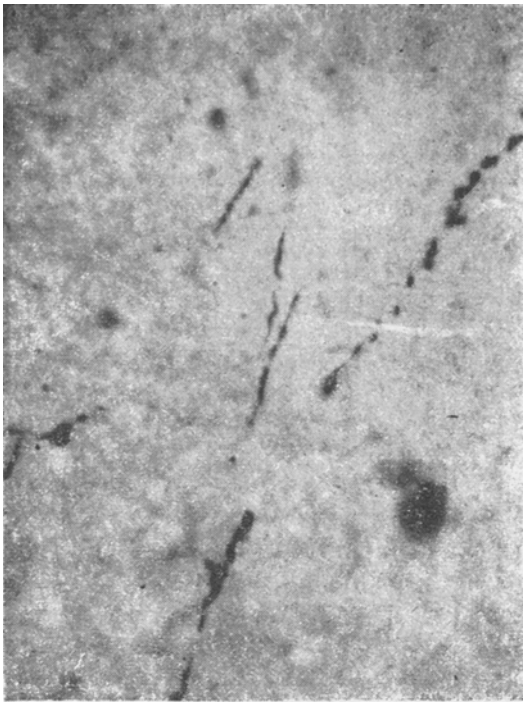

Fig. 1. Degenerative changes in a bundle of thin, radial fibers in the inferior divisions of the cortex of projection zone 1 of the splanchnic nerve after extirpation of zone 2. Impregnation by Nauta's method. Ocular 12.5, objective 60x, immersion.

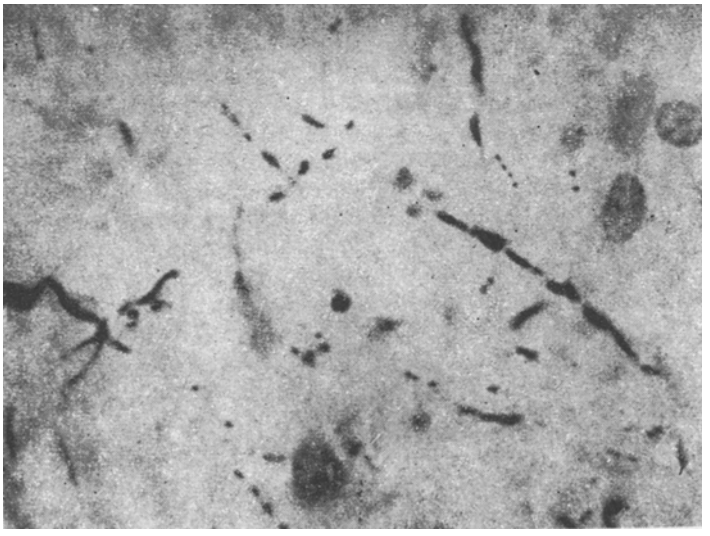

Fig. 2. Fragmentation and cloudy swelling of thin radial and horizontal fibers in the middle divisions of the cortex of projection zone 2 of the splanchnic nerve after extirpation of zone 1. Impregnation by Nauta's method. Ocular 12.5, objective 60x, immersion.

After "undercutting" of the white matter situated immediately below projection zone 2 of the splanchnic nerve, degenerative changes were seen in the cortex of zone 1, mainly of the thin radial fibers. After excision of the cortex of projection zone 2 of the splanchnic nerve to the required depth, no degenerated fibers were observed in the cortex of zone 1.

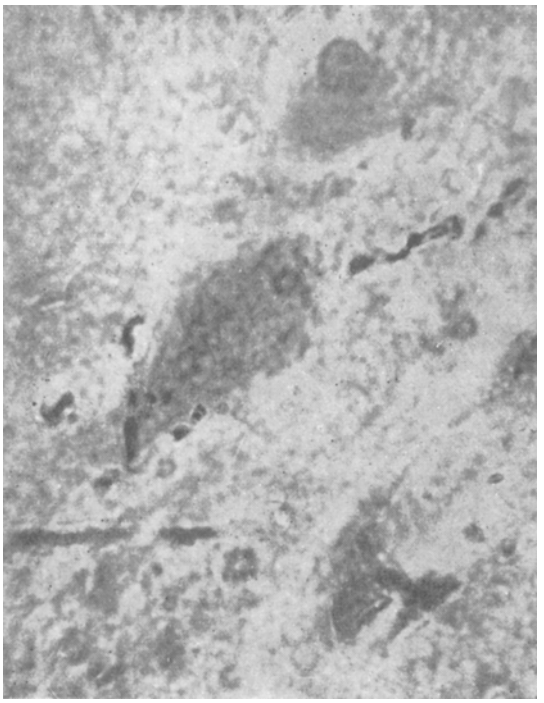

Fig. 3. Fragmentation of terminals on a cell body. Impregnation by Nauta's method. Ocular 12.5x, objective 100x, immersion.

Cortex of projection zone 2 of the splanchnic nerve. Microscopic investigation of sections of the cortex of projection zone 2 of the splanchnic nerve after extirpation of zone 1 revealed massive irreversible changes in the thin fibers of the radial and horizontal bundles. The latter were observed most frequently in the inferior and middle layers, although single degenerated horizontal fibers were present in the superior layers also. The degenerated fibers were composed of argentophilic, varicose thickenings, breaking up into separate fragments (Fig. 2). Alongside them were very thin terminal fibers, also undergoing degeneration (Fig. 3). In some sections whole groups of fibers showed cloudy swelling.

After "undercutting" of the white matter situated beneath the cortex of projection zone 1 of the splanchnic nerve, irreversible changes were observed in the cortex of zone 2, mainly in the radial fibers running from the inferior layers of the cortex towards the middle layers. In the same sections a few degenerated horizontal fibers were seen in the middle layers. After excision of the cortex of projection zone 1 to the required depth, the cortex of projection zone 2 revealed multiple lesions of the horizontal systems of fibers and of individual radial fibers.

Histological investigation of areas of the cortex corresponding to the projection zones of the splanchnic nerve showed that after operation on one projection zone, degenerative changes were consistently seen in the fibers in the cortex of the other zone. These fibers were systems of radial and horizontal bundles. Their associative character was demonstrated, on the one hand, by the fact that degeneration affected the terminal divisions of the fibers, situated immediately next to the cells, and on the other hand, by the degeneration of the radial fibers, many of which are terminals. Hence, it may be concluded that the connection between the cortical projection zones of the splanchnic nerve is a two-way system, i.e., the projection zones 1 and 2 communicate with each other through systems of association fibers.

As a rule many more fibers passed from zone 1 to zone 2 than vice versa. Many of the former fibers belonged to the horizontal systems, whereas the fibers passing from zone 2 to zone 1 were mainly radial fibers. Hence the number of fibers passing from one zone to the other was not identical.

SUMMARY

The presence of bilateral anatomical relation between the 1 and 2 cortical zones of the splanchnic nerve was established by the method of terminal degeneration. There is a difference in the reciprocal interchange of fibers between the cortical zones of the splanchnic nerve: a much greater number of fibers enters the 2 zone from the 1. A considerable part of the fibers belongs to horizontal systems, whereas the fibers coming from the 2 zone to the 1 zone belong mainly to radial fibers. Thus, the interrelations between the connecting systems of the 1 and 2 splanchnic nerve zones are such that the number of fibers coming from one zone into another one are different.

LITERATURE CITED

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