## Adrenergic Nerve Endings in the Feline Cervical Superius Ganglion

One of the most interesting results in the histochemistry of catecholamines is the discovery of numerous adrenergic terminals within the sympathetic ganglia[1,2]. Adrenergic terminals are abundant in the ganglium stellatum, ganglium coeliacum, ganglium mesentericum inferius of the cat, as well as in the ganglium cervicale superius of the rabbit and, to a lesser extent, in the rat[2]. According to the same authors, however, no such terminals could be found in the cervical superius ganglion of the cat.

The frequent occurence of adrenergic terminals in autonomic ganglia suggests their role in impulse transmission. According to an attractive hypothesis proposed by Norberg and Sjöquist[2], the positive P-wave (membrane hyperpolarization[3]) observed in curarized ganglia after presynaptic volleys, would be due to catecholamines released by these terminals. Yet their absence from the feline cervical superius renders such a functional generalization impossible. It is, therefore, of utmost importance to find out the reason why adrenergic terminals cannot be detected in the cervical superius ganglion of the cat.

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[1] B. Hamberger, K.-A. Norberg and F. Sjöquist, Int. J. Neuropharmac. 2, 279 (1963).

[2] K.-A. Norberg and F. Sjöquist, Pharmac. Rev. *18*, 740 (1966).

[3] The P-wave follows the initial negativity (N-wave) and precedes the late negative (LN-wave), these 2 waves being due to cholinoceptiv loci[4,5].

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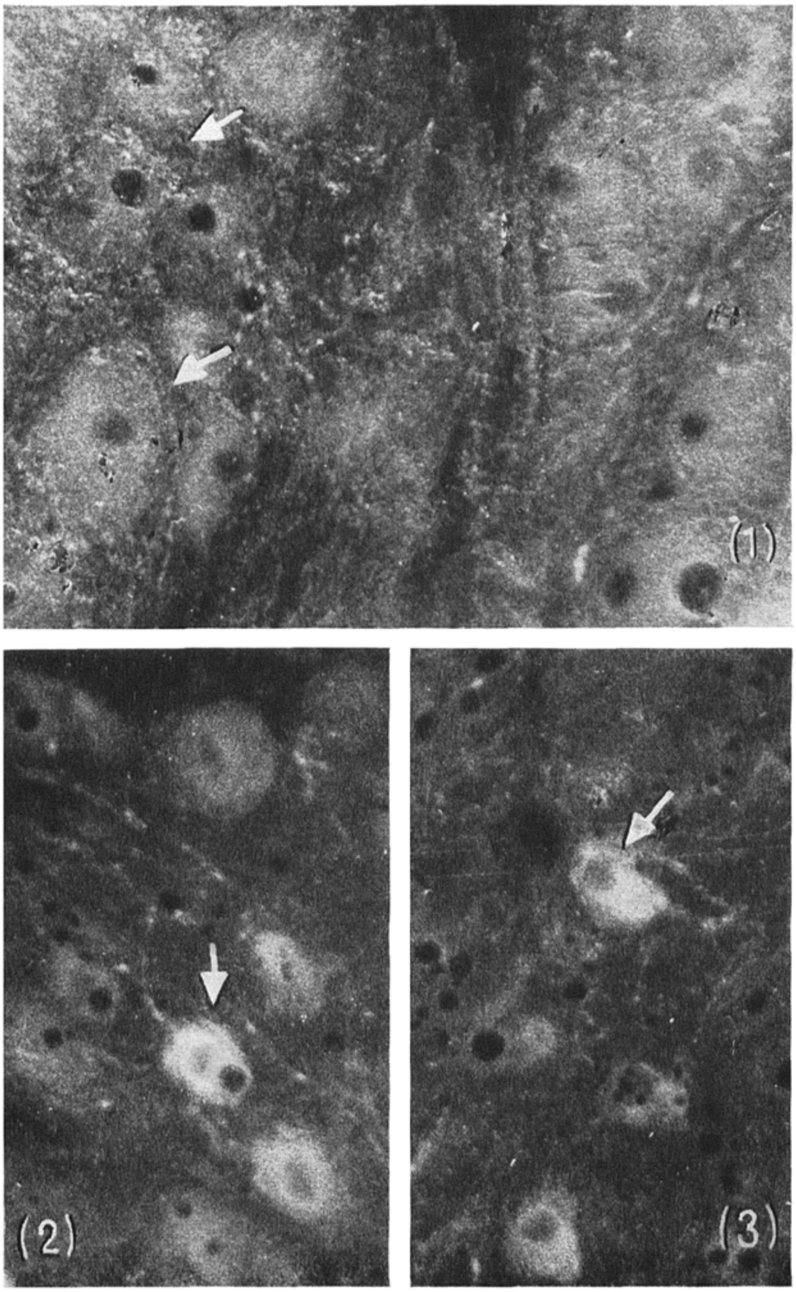

All micrographs illustrate catecholamine-induced fluorescence in the feline cervical superius ganglion. (1) Fluorescent adrenergic terminals around ganglion cells. The plexus of adrenergic fibres is especially abundant at the areas marked by arrows. (2) One of the strongly fluorescent ganglion cells (arrow) with a cell process (axon?) exerting the same degree of reaction. (3) Fluorescent nerve cell with a recurrent axon collateral (arrow) suggesting the intraganglionic origin of pericellular nerve plexuses. Filters: BG-12 and OG-1. Magnification × 360.

The technique used by Norberg and Sjöquist for the identification of intraganglionic adrenergic terminals is identical with that described by Falck[6]. This technique involves the use of frozen-dried specimens, subjected to formaldehyde vapours, resulting in a brightly fluorescent condensation product of norepinephrine (6,7-dihydroxy-3,4-dihydro-iso-quinoline). Recently we reinvestigated the norepinephrine-induced fluorescence of autonomic ganglia using cryostat sections instead of frozen-dried specimens. This modification[7] renders it possible to study large tissue sections instead of the small blocks preferable for freezing-drying.

With regards to the stellate, coeliac and inferior mesenteric ganglia, our results were more or less identical with those reported by the Swedish group. We have found, however, a fair number of adrenergic terminals also in the cervical superius (Figure 1) that originated from strongly fluorescent cells (Figure 2). At least some of these fibres correspond to axon collaterals (Figure 3). No real chromaffine cells could, however, be found in the cervical superius, though such cells were present in all the 3 other feline ganglia studied.

What is the reason for the apparent differences between our results and those of Norberg and Sjöquist? It is improbable that adrenergic terminals were more completely preserved in cryostat sections than in frozen-dried specimens. A more likely explanation is the peculiar structure of the common cervical vago-sympathetic ganglion. In the cat, the superior sympathetic and the inferior vagal (nodose) ganglion are located in a common connective tissue sheath. When using small tissue blocks for freeze-drying, one is subjected to the pitfall of collecting samples from the nodose part of this joint ganglion. In our large cryostat sections, however, one distinctly sees the green-yellow fluorescence of the sympathetic ganglion and the virtually negative nodose ganglion, where the only fluorescent material is the lipofuscine pigment in the sensory ganglion cells.

The role of catecholamines in the modulation of ganglionic responses has been repeatedly discussed since the early observations of Marrazzi[8]. Eccles and Libet[5] ascribed the catecholamine-induced P-wave to intraganglionic chromaffine cells. The observations reported above suggest that in the cervical superius ganglion, as well as in other sympathetic ganglia, the pericellular adrenergic nerve fibres furnish an adequate structural basis for the release of catecholamines within the ganglion.

*Zusammenfassung.* Fluoreszenzmikroskopische Untersuchungen beweisen die Anwesenheit adrenergischer Terminale im Ganglion cervicale superius der Katze. Die meisten von ihnen stammen aus Axon-Kollateralen. Eine intraganglionäre Hemmung scheint auch im Ganglion c.s. über adrenergische Nervenendigungen zu laufen.

B. Csillik, G. Kâlmán and
Elizabeth Knyihár

*Department of Anatomy, University Medical School, Szeged (Hungary), 13th January 1967.*

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## Influence of Side Position on Hippocampal Afterdischarge (HAD) in the Rabbit

Both labyrinthine and optic nystagmus are due to asymmetric excitation of the pathways concerned. The asymmetry of these reflexes finds an expression not only in the way in which they interact with each other[1,2], but also in their influence on other responses of the CNS. Thus in the rabbit, labyrinthine stimuli, producing nystagmus to the left, inhibited only the hippocampal afterdischarge (HAD), following electrical stimulation of the left dorsal hippocampus. The same vestibular stimulus had no effect, or occasionally even produced enhancement of the HAD, when the right hippocampus was excited[3].

Another form of asymmetrical labyrinthine stimulation is provided by side position. Thus when the head of an animal rests on the right side, the right saccule is excited more intensely than the left one[4]. Therefore side position exerts again an asymmetric influence on optic nystagmus[5]. It was thus of interest to determine whether a given side position might produce a different effect on the HAD, evoked from the left or right hippocampus of the rabbit.

*Method.* Under local anaesthesia, one pair each of bipolar, concentric electrodes were placed into the left and right dorsal hippocampus of a rabbit. Square wave pulses of 2 msec duration were supplied at a frequency of 40/sec from a Tektronix pulse generator, which triggered a constant current source. Stimulation lasted always for 5 sec. The electrical activity of the hippocampus was registered bilaterally on a Schwarzer electroencephalograph. Control records were taken, while the animal was lying in a hammock in prone position. The hammock was then turned slowly into side position and remained there for 10 min before stimulation was started again. During the experiment, both eyes were protected from light.

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