MORPHOLOGY AND PATHOMORPHOLOGY

THE RECEPTORS OF THE MAIN VEINS OF THE LIMBS IN DOGS AND MONKEYS*

A. G. Fedorova

From the Department of Normal Anatomy (Head – Corresponding Member of the AMN SSSR Prof. B. A Dolgo-Saburov) of the S. M. Kirov Order of Lenin Military Medical Academy, Leningrad

(Received August 9, 1957. Presented by Active Member of the AMN SSSR V. N. Chernigovskii)

Sensory nerve endings in the veins were first reported by A. S. Dogel' in 1898. He found nerve endings in the form of plates in the external coat of the veins of the heart. Reports have accumulated over a long period of time of the presence of receptors in various venous trunks [12, 22, 23] but descriptions of sensory nerve endings in the veins have usually been the result of fortuitous observations.

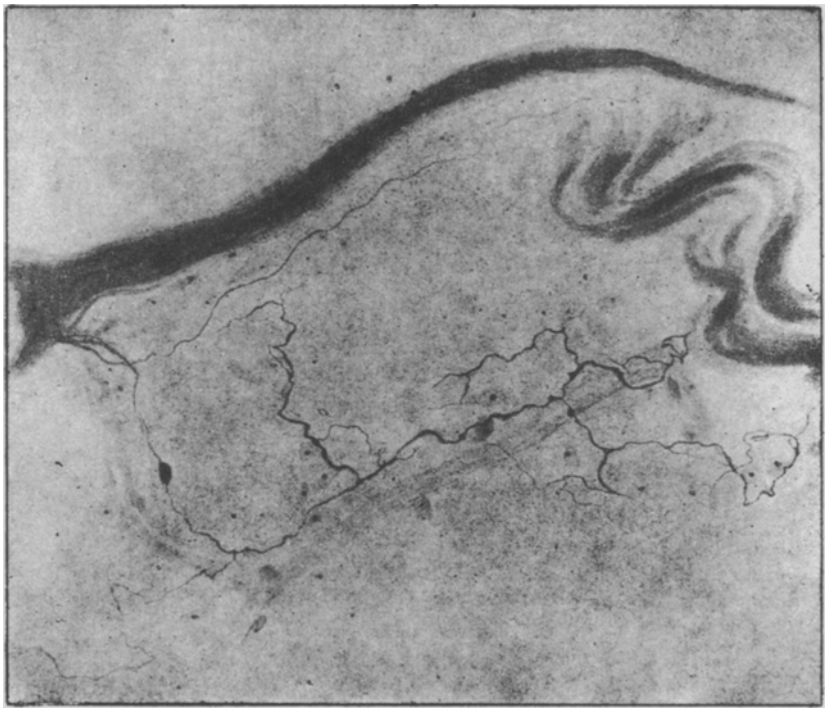

Fig. 1. The receptor apparatus in the adventitia of the wall of the great saphenous vein (in the upper third of the leg of an adult dog). Ramification of the receptor fiber among the network of vasa venarum. Bielschowsky--Gross impregnation. Magnification: ocular 10 ×, objective 40 ×.

* The substance of a dissertation submitted towards the degree of doctor of medical sciences.

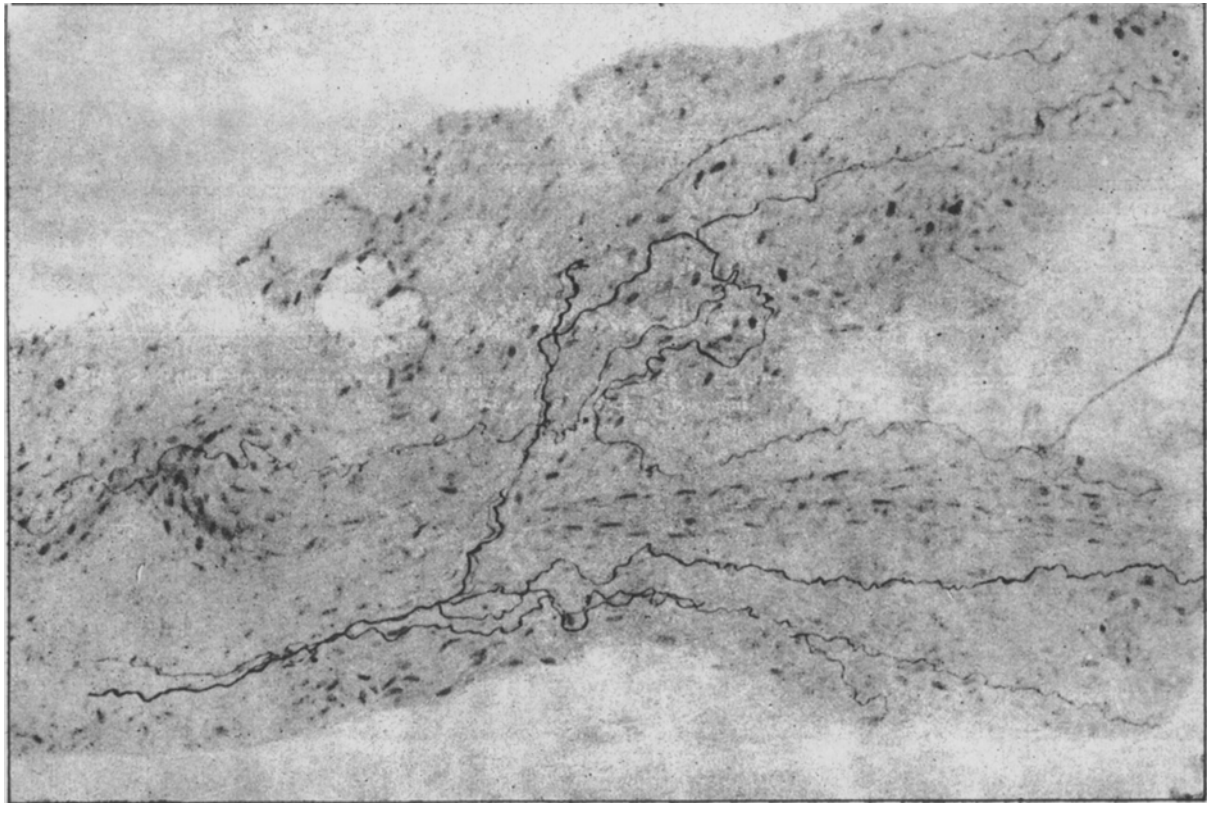

Fig. 2. The receptor apparatus in the adventitia of the cephalic vein (upper third of the arm of an adult dog). Bielschowsky-Gross silver impregnation. Magnification: ocular 10×, objective 40×.

Fig. 3. One of the myelinated fibers of a nerve bundle in the adventitia of the brachial vein of the monkey (adult male Papio hamadryas). It is seen that the fiber divides into two branches, forming encapsulated endings of the Vater-Pacini corpuscle type. Bielschowsky-Gross impregnation. Magnification: ocular 10 X, objective 40 X.

Extensive research on this problem has been conducted by V. V. Astakova and his co-workers [1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 14, 15, 16, 17, 19, 20]. They did not confine themselves to describing the receptors under normal conditions of existence but they also studied the sources of origin of the nerve endings and their genesis, and the state of the nervous apparatus of the veins during clinical and experimental pathological conditions.

On the basis of numerous comprehensive investigations the presence of nerve endings was demonstrated in all the layers of the walls of the veins, including the endothelium. A double sensory innervation (bulbar and spinal) was shown by experimental means in the caval and pulmonary veins. The bulbar receptors were found to be more sensitive to all forms of action on the body (oxygen lack, experimental fever).

So far the problem of receptors in the walls of the veins of the limbs has received little attention; in the literature there are only isolated papers dealing with this subject, and the material is either incomplete [13] or quite unconvincing [18].

Our attention was directed to this problem in connection with the study of the collateral circulation developing as a result of resection of the main veins of the limbs. We investigated the nervous apparatus in the walls of the brachial, cephalic, femoral, and greater and lesser saphenous veins at various levels in 10 dogs and 6 monkeys (Papio hamadryas). The material was treated by the Bielschowsky-Gross silver impregnation method, the preparations being counterstained with hematoxylin. The sections varied in thickness between 30 and 90 μ.

As examination of the preparations obtained showed, in all the layers of the walls of the veins listed there are plexuses of unmyelinated and myelinated nerve fibers of medium caliber. The receptors formed by these belong mainly to the group of free nerve endings, with very extensive branching. Branches of the most diverse shapes are found – from simple antenna-like divisions of the nerve fiber to more complicated (Fig. 1) ramifications extending through many fields of vision (Fig. 2). More rarely it was possible to see encapsulated receptors of the Vater-Pacini corpuscle type, oblong in shape. In section it is possible to see clearly their external capsule and internal bulb. The nerve fiber at one pole of the corpuscle divides into several branches, terminating inside the bulb in pin-head thickenings. As seen in Fig. 3 a thin collateral emerges from the thick medullated fiber, proceeding with the thick fiber into the bulb.

We could find no endings with restricted ramification (de Castro's second type) in any of our preparations.

From an analysis of the receptor patterns it may be suggested that the main veins of the limbs receive their sensory innervation from the posterior roots of the spinal nerves. These endings, as we have seen, have usually an antenna-like shape and their branches extend over a wide area. B. A. Dolgo-Saburov and his co-workers established by a large number of observations and animal experiments that such receptors belong to the spinal group, i.e., they are formed from endings of the peripheral processes of the neurones of the spinal ganglia.

From a comparison of material obtained from dogs and monkeys no individual peculiarities could be distinguished. In the same way there were no differences in receptors in different veins (deep and superficial veins, veins of the fore- and hindlimbs).

SUMMARY

The results of investigation of the nervous apparatus in the walls of the brachial, cephalic, femoral, small and large saphenous veins, examined on various levels, are presented. 10 dogs and 6 monkeys (Papio hamadryas) were used for this experiment. The specimens were silver impregnated by the Bielschowsky-Gross' method. The presence of a network of nerve fibers of average size was found in all these veins. Receptors, formed by them, belong mainly to the group of free nerve endings. The latter are found in various forms from a simple branching of the nerve fiber to more complicated ramifications which spread to many fields of vision. Encapsulated receptors of Vater-Pacini type were more scarce. These receptors, as was established by B. A. Dolgo-Saburov and his collaborators on the basis of a considerable number of observations and experiments on animals, are related to the spinal group, i.e., they are formed by the terminations of the peripheral neurons of the spinal ganglia.

LITERATURE CITED

[1] V. V. Astakhova, Annotations of Scientific Papers of the AMN SSSR in 1954,* p. 95, Moscow, 1955.

[2] Idem, Biull. Eksptl. Biol. i Med. No. 2, 105-108 (1957).**

[3] V. M. Godinov, Collected Abstracts of Scientific Papers of the Department of Normal Anatomy of the Naval Medical Academy (1942-1944),* 2, pp. 17-18, Leningrad, 1946.

[4] Idem, Transactions of the Military Medical Academy,* vol. 17, pp. 107-116, Leningrad, 1949.

[5] Idem, Ibid. vol. 50, pp. 34-45, Leningrad, 1953.

[6] A. S. Dogel', Obzor. Psikhiatr., Nevrol. i Eksptl. Psikhol. No. 8, 577-599 (1897).

[7] B. A. Dolgo-Saburov, Transactions of the Naval Medical Academy,* vol. 3, No. 2, pp. 3-21, Leningrad, 1944.

[8] Idem, Ibid. vol. 11, pp. 30-40, Leningrad, 1948.

[9] Idem, Vrachebnoe Delo No. 10, 903-909 (1950).

[10] Idem, Transactions of the Naval Medical Academy, vol. 17, 147-164, Leningrad, 1949.

[11] Idem, Transactions of the Military Medical Academy,* vol. 50, pp. 20-33, Leningrad, 1953.

[12] G. I. Zabusov, Biull. Eksptl. Biol. i Med. 12, 3-4, 204-206 (1941).

[13] G. F. Ivanov, Nerves and Organs of Sensation of the Cardiovascular System,* Moscow-Leningrad, 1945.

[14] V. V. Kupriianov, Biull. Eksptl. Biol. i Med. No. 10, 291-294 (1950).

[15] Idem, Innervation of the Vessels of the Lesser Circulation,* Dissertation, Leningrad, 1953.

[16] I. D. Lev, Urologiia No. 4, 41-47 (1955).

[17] G. F. Makeeva, Khirurgiia No. 9, 66-70 (1956).

[18] G. F. Mal'kov, Transactions of the Naval Medical Academy,* pp. 86-90, Leningrad, 1948.

[19] Idem, Transactions of the Military Medical Academy,* vol. 50, pp. 181-191, Leningrad, 1953.

[20] J. F. Nonidez, cited by V. V. Kupriianov, 1953.

* In Russian.

** Original Russian pagination. See C.B. Translation.