AN EXPERIMENTAL MORPHOLOGICAL INVESTIGATION OF THE INNERVATION OF THE INGUINAL LYMPH NODES IN THE DOG

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The innervation of the lymph nodes has been in subject of a rather large number of investigations but there is little information on the origin of the nerves. This is particularly true of the inguinal lymph nodes.

The work of Yu. S. Yakovlevaya, A. G. Reminnaya, V. M. Skoritskaya [7], N. A. Kurdyumov [4] and V. M. Klebanov [3] was based on anatomic preparations which led to the conclusion that in man and animals the nerves entering the inguinal nodes originated from the lumbar plexus as well as from the plexus in the walls of the blood vessels of the nodes. V. M. Klebanov [3] tried to show that in rats and cats, severing the lumbar nerve trunks and the neighboring ganglia of the sympathetic chain led to a degeneration of the nerve fibers in the inguinal lymph nodes.

More recently the method of extripating the regional spinal and autonomic ganglia has been applied in the study of the innervation of lymph nodes with subsequent histologic study of the nerves in the nodes. These investigations involving the cervical [1], submaxillary [6], popliteal [2] and axillary [5] nodes established that in all probability the cerebrospinal and autonomic systems participate in the innervation of the nodes.

These observations led us to use the same experimental histologic method for studying the origin of the nerves supplying the inguinal lymph nodes.

METHODS

The investigation was carried out on 35 adult dogs. Groups of animals had either a unilateral or bilateral extirpation of the sympathetic ganglia in the lumbar and sacral regions. In other groups unilateral or bilateral extirpation of the lumbar and sacral paraspinal ganglia was performed in the following combinations: L_1-L_2, L_2-L_3, L_4-L_5, L_4-L_5-S_1 S_1-S_4, and S_2-S_4.

After varying periods (from 3 to 8 days) the animals were killed and the inguinal nodes were removed for histologic study. Following fixation in 20% neutral formalin, the nodes were sectioned with a cooled microtome and the sections were impregnated with silver according to the method of Bilshovsky-Gross.

RESULTS

Microscopic investigation of the lymph nodes of the dogs three days after unilateral severing of the lumbar sympathetic ganglia showed that some nerve fibers in the node as well as in the blood vessels of the node were fragmenting and isolated nerve fibers were even in a state of granular disintegration. In the vast majority of instances the nerve fibers displayed absolutely no change. Only one or two of the nerve filaments in a fiber of 10 or 15 axons showed any degeneration. On the whole 10 to 15% of the axons were destroyed in each nerve fiber. This was observed in both the cortical and medullary portions of the node as well as in the blood vessels entering the node.

With unilateral extirpation of the lumbar and upper sacral sympathetic fibers, a greater number of degenerating fibers were seen in the cortical and medullar portions of the nodes and in the blood vessels of the node than when unilateral extirpation of the lumbar fibers alone was done.

Microscopic investigation of the lymph nodes in three days after bilateral extirpation of the lumbar sympathetic ganglia showed that the number of degenerating fibers in the nodes was far greater than after unilateral sectioning. Only rarely were unchanged axons encountered in this instance, and only in rare cases could one encounter small nerve fibers with absolutely normal axons in the medulla and cortex of the nodes.

Bilateral section of the lumbar and upper sacral trunks, as seen under the microscope, led to massive destruction of the nerve filaments in the lymph nodes (Fig. 1) and normal axons were encountered with exceptional rarity.

To ascertain if innervation is bilateral inguinal nodes on the left side were examined 3 days after transection of the right lumbar or lumbar and upper sacral sympathetic chains.

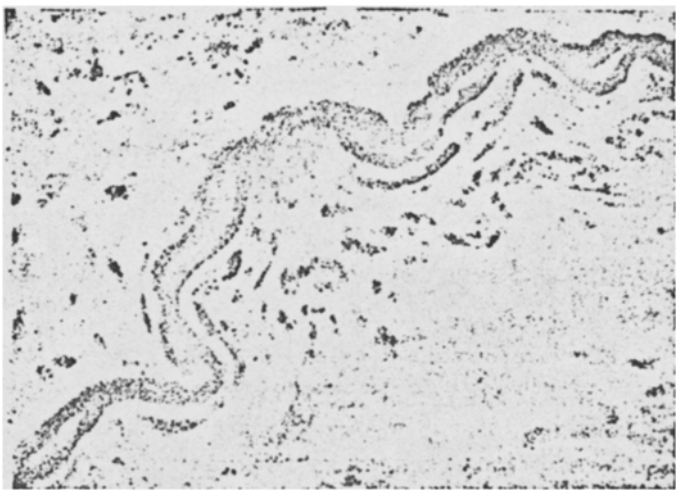

Fig. 1. Degenerating axons in the left inguinal node of a dog 3 days after left sided transection of the lumbar and sacral sympathetic trunks. Stained by the method of Bilshovsky-Gross. 40 × objective, 7 × eyepiece.

In the first case, i.e., after severance of the right lumbar nerves, isolated degenerating fibers were seen in the left inguinal nodes.

In the same nodes, after right sided transection of the lumbar and upper sacral nerves of the sympathetic chain, there was somewhat more degeneration in the nerves than in the preceding instance.

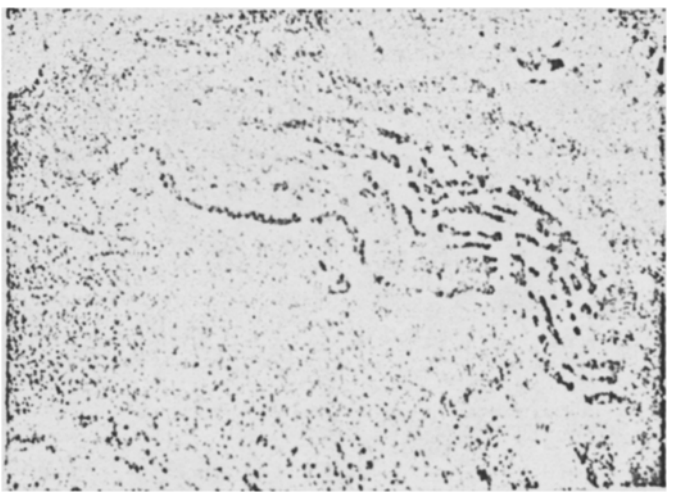

Fig. 2. Degeneration of axons in the inguinal lymph node of a dog (left side) 6 days after left sided transection of the fifth lumbar and first and second sacral ganglia. Stained according to the method of Bilshovsky-Gross. Objective 40 ×, eyepiece 7 ×.

Thus it can be considered as established that in the dog the innervation of inguinal lymph nodes stems from lumbar and sacral sympathetic nerves of the ipsilateral and centralateral sides.

Microscopic examination of the inguinal nodes 6 days after unilateral severence of lumbar nerves in varying combinations (L_1-L_2, L_2-L_3, L_4-L_5) demonstrated an absence of degenerative changes in the axons. Consequently we arrived at the conclusion that the lumbar spinal nerves bear no relation to the innervation of the lymph nodes in question.

At the same time degenerating axons were consistently seen in the capsule and medullary portion of the nodes when the following spinal nerves were transected: L_4-L_5-S_1, S_1-S_2-S_3-S_4 (Fig. 2).

However when we sectioned the second, third and fourth sacral nerves (S_2-S_3-S_4) degeneration of the axons was not noted at all.

In other words degeneration of the axons in the inguinal lymph nodes was only seen when the first sacral nerve was sectioned along with other nerves.

Although we did not succeed in sectioning the first sacral ganglion alone, from the data which has been given it can be concluded that axons in the nerve fibers of the inguinal nodes of the dog are derived from the first sacral ganglion; thus it has been shown that there is also cerebrospinal innervation of the aforementioned nodes.

SUMMARY

The authors has detected degeneratively changed nerve fibers in the inguinal lymph nodes of dogs, in some cases after excision of the sympathetic trunk at the lumbar and superior sacral level and in others – after excision of the lumbar and sacral spinal cord ganglia.

Thus it was found that the inguinal lymph nodes of dogs are innervated mainly at the expense of the lumbar and sacral portions of the sympathetic trunk on the ipsilateral and, partially, on the contralateral side. A small number of cerebrospinal nerve fibers penetrate into the mentioned lymph nodes from the first sacral spinal ganglion.

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