# THE MECHANISM OF THE EFFECT OF THE POSTERIOR ROOT GANGLIA ON SMOOTH MUSCLE

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A number of investigations [1, 4, 7, 9, 13] have been made of the effect of the dorsal root ganglia on smooth muscle. Nevertheless, much remains to be found concerning the mode of action of the posterior root fibers.

According to Kenkure [11], the dorsal spinal roots contain afferent parasympathetic fibers. L. A. Orbeli [8] has shown that in the dorsal roots there are autonomic fibers which make synaptic contact with the sensory cells of the ganglion. From the spinal ganglia nerve impulse spread antidromically along the the outgrowths from these cells.

A. V. Kibyakov [4] perfused frog hind limbs, and found that fluid taken from veins during excitation of the posterior roots was capable of dilating blood vessels of another frog. On this account it has been suggested that transmission of excitation in the posterior roots is mediated by acetylcholine.

An active acetylcholine-like substance has also been found in similar experiments by other workers [2, 10, 12].

Posterior root fibers which cause contraction of the canine intestine lose their motor influence after pancreas has been removed [3], and it has been found that there is then a disturbance to the formation of acetylcholine in the body [5, 6]. However, it has frequently been denied [14, 15] that acetylcholine is liberated during excitation of sensory nerves.

In the present work, an attempt has been made to determine the influence of the posterior roots on the smooth muscle of the urinary bladder, and on the m. retractor penis of the dog, and to find to what extent acetylcholine is involved.

## METHODS

The experiments were performed on dogs under ether-chloroform anesthesia. The animals were placed in position with the dorsal surface uppermost. The vertebral canal was opened at the level of the lower-lumbar and upper sacral segments. The spinal cord was exposed by a longitudinal cut in the meninges, after which a dissection was made at the dorsal roots which were then severed. The peripheral ends of the cut roots of the posterior two lumbar and anterior two sacral segments were ligatured and placed on buried electrodes. The wound was then closed by clips, and the animal was placed on its back, and the abdominal cavity opened. A purse-string suture was made at the base of the urinary bladder, an aperature was made in the wall and a rubber balloon was introduced into the cavity, connected to a U-shaped manometer by an air and water transmission system. A preparation was then made of the peripheral end of the m. retractor penis, which lay in the perineal region extending to the midline as a cord consisting of two thick bundles. The peripheral end of the muscle was cut and joined through a system of two pulleys to a lever recording on a smoked drum. Stimulation was applied from an induction coil supplied by a 2 v from a storage cell.

## RESULTS

In the first set of experiments, stimulation of the fourth and fifth lumbar dorsal roots caused the bladder to contract. The contraction caused the height of the curve to increase to three times or more the normal height (Fig. 1a). In some experiments the effect was weak, or did not occur at all. This result was evidently due to the initial motor activity of the bladder, on which the effect of dorsal root stimulation was superimposed. In these experiments, the so-called spontaneous activity of the bladder usually did not occur.

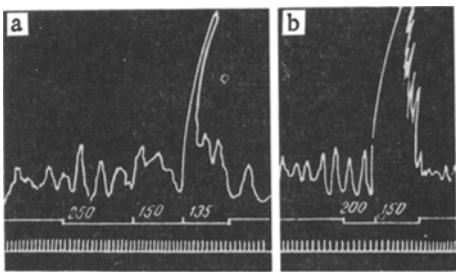


Fig. 1. Change in the contractions of the urinary bladder. a) On stimulating dorsal roots; b) same, after injecting eserine.

The response of the m. retractor to stimulation of the fifth lumbar and first two sacral dorsal roots was the opposite of that shown by the urinary bladder, and in each case there was a marked relaxation of the muscle (Fig. 2a).

To determine the mechanism of the action of the dorsal roots on the bladder and m. retractor, a second set of experiments was carried out in which the dog received

2-3 ml of 1 : 10,000 eserine and 6 mg per kg body weight of cocaine.

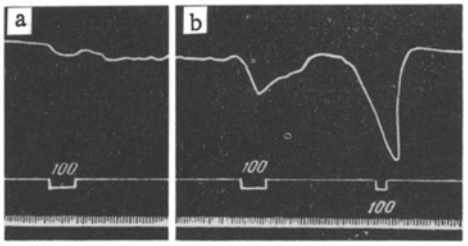


Fig. 2. Change in the contraction of the m. retractor. a) On stimulating the 1st lumbar dorsal root; b) same, after injecting eserine.

Stimulation was applied to the dorsal roots 30 min after injecting eserine. In all the experiments, when the eserine was injected for $1\frac{1}{2}$-2 hours there was both a greater contraction of the bladder (Fig. 1b) and a greater relaxation of the m. retractor (Fig. 2b). In cases where there had been no effect was always well shown after. In this way, the excitability of the dorsal roots was considerably enhanced. After injecting cocaine, dorsal root stimulation had no effect either on the retractor muscle or on the bladder.

The results of the experiments have shown that dorsal root stimulation causes responses from the urinary bladder and m. retractor to occur. The reaction is enhanced by eserine injection, but not influenced by cocaine. The results indicate that acetylcholine is involved in the mechanism of transmission of impulses via the dorsal roots. In this way acetylcholine comes to play an important part in the dorsal root activity as affecting different structures such as the urinary bladder and retractor penis muscle.

## SUMMARY

The posterior roots of the lumbar and sacral regions of the dog spinal cord were stimulated, and the effect on the smooth muscle of the urinary bladder and m. retractor penis found. The wall of the bladder contracted and the m. retractor penis relaxed. The reaction was intensified by eserine but was not affected by cocaine. Therefore, acetylcholine plays a significant part in the action of the posterior roots on these muscles.

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