

THE ACTION OF ACIDS AND ALKALIES ON THE CHEMORECEPTORS OF THE INTESTINE IN ASCARIASIS

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In our previous investigations [5, 6, 7], we showed that as a result of the action of toxic products secreted by ascarides, the chemoreception of a number of stimulants (carbon dioxide, acetylcholine) is disturbed. In the present research, studies were made of the disturbance of the mechanisms of chemoreception associated with ascariasis.

For this purpose, we investigated the action of several acids and alkalies on the chemoreceptors of the intestine after the latter had been in contact with the helminthotoxins of ascarides.

EXPERIMENTAL METHOD

Experiments were carried out on 47 cats under intravenous urethane anesthesia. A loop of bowel was isolated from the general circulation of blood by V.N. Chernigovskii's method [3], and perfused with oxygenated Ringer-Locke solution at a temperature of 38°.

The arterial pressure in the carotid artery was recorded by means of a mercury manometer, and the respiration by a Marey's capsule, through a tracheal cannula.

The stimulants used were solutions of acids (acetic 0.5-1.0%, hydrochloric N/100, lactic 1.5-2.0%, NaH_2PO_4 N/2) and alkalies (sodium bicarbonate 1.5-2.0%, Na_2HPO_4 N/2). The substances to be tested were injected into the intestinal perfusing fluid by means of a syringe, in doses of 1-2 ml, before and after treatment of the bowel with material containing the toxic products of ascarides. Such material consisted of an aqueous extract of the parasites Ascaris suum, prepared by E. N. Pavlovskii's method.

EXPERIMENTAL RESULTS

All the chemical compounds which we tested before the action of the toxic products of ascarides elicited a reflex increase in the arterial pressure and stimulation of respiration through the chemoreceptors of the intestine.

After injection of an aqueous extract of ascarides (1-2 ml of a dilution of 1×10^{-1} to 1×10^{-2}) into the intestinal vessels, the reflex reactions were changed.

In the overwhelming majority of experiments, after the action of the toxic products of ascarides, the same stimuli (in the same volume and concentration) caused biphasic pressor-depressor or purely depressor reactions of the arterial pressure. The pressor phase of the arterial pressure was often below the initial value. The duration of the reaction lengthened considerably. In individual cases, the reaction was absent after injection of the extract. Respiration usually reacted by inhibition.

Particularly noteworthy was the fact that after the action of the helminthotoxins of ascarides, the reflexes from the chemoreceptors of the intestine, elicited by both acids and alkalies, were affected qualitatively in the same way (Figs. 1 and 2).

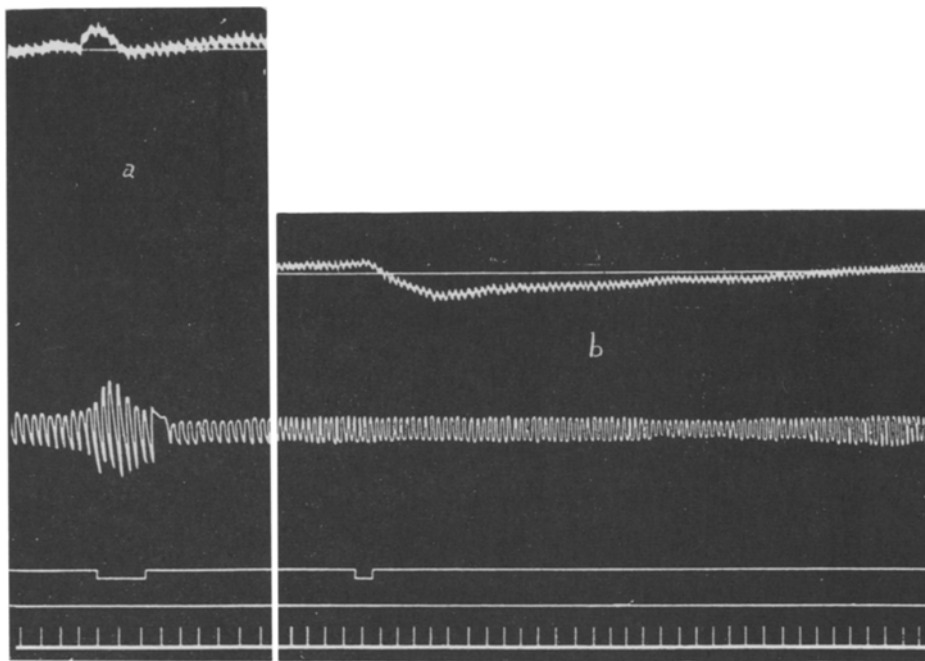


Fig. 1. Reflex change in the arterial pressure and respiration in response to stimulation of the chemoreceptors of the intestine by a 1% solution of acetic acid: a) before the action, and b) after the action of extract of ascarides. Significance of the curves (from above down): arterial pressure (mercury manometer), initial level of the arterial pressure, respiration, stimulus marker, manometer zero line, time marker (5 seconds).

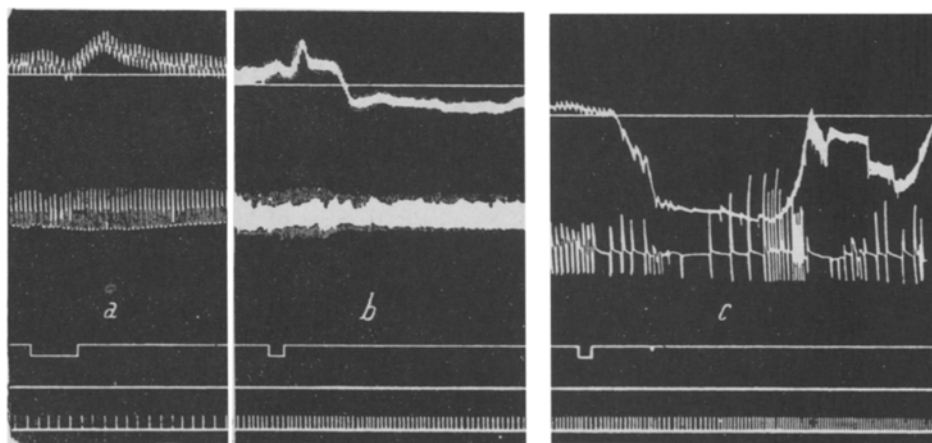


Fig. 2. Reflex change in the arterial pressure and respiration in response to stimulation of the chemoreceptors of the intestine with a 1.5% solution of NaHCO_3 : a) before the action of ascarid extract; b) after the action of 1 ml of 1×10^{-1} ascarid extract; c) after the action of 4 ml of 1×10^{-1} ascarid extract. Significance of the curves as in Fig. 1.

V. N. Chernigovskii and V.A. Lebedeva [2] observed the appearance of vascular pressor-depressor and depressor reflexes and inhibition of respiration after treatment of the isolated bowel with moniodoacetate in association with the action of acids only, whereas the reflexes elicited by stimulation of the chemoreceptors by alkalies did not undergo any qualitative changes under these circumstances, or were increased in intensity.

They studied the action of many acid and alkaline compounds, including also compounds such as NaH_2PO_4 and Na_2HPO_4 . Monosodium phosphate in aqueous solution (N/2) is known to have an acid reaction, but the disodium salt, in the same concentration, is alkaline.

Experiments in which NaH_2PO_4 and Na_2HPO_4 were injected confirmed this relationship and the view put forward regarding the existence of a dual mechanism of chemoreception of different stimulants.

When our experimental results were compared with the data in the literature, it was noticed that, in contrast to monoiodoacetic acid, the toxic products of ascarides led to profound changes in the mechanisms of chemoreception during the action of both acids and alkalies.

The experiments with NaH_2PO_4 and Na_2HPO_4 were characteristic in this direction. After the action of the toxic ascarid products, mono- and disodium phosphate, although differing in their reaction, produced the same reflex changes through the chemoreceptors of the intestine as those which we observed after the action of other acids and alkalies.

Evidently, both mechanisms of chemoreception [4] may thus be disturbed by the action of the ascarid helminthotoxins.

These disturbances of the mechanisms of chemoreception were evidently connected with biochemical changes in the receptor field. This was to some extent revealed by the change which we observed in the pH of the perfusate flowing from the veins of the perfused loop of bowel after the action of the toxic ascarid products.

The changes in the character of the arterial pressure and respiration reactions in response to the substances under test during poisoning by toxic ascarid products indicated changes in the excitation of the chemoreceptors under these conditions.

According to the modern view [1], pressor-depressor and depressor reactions in response to carbon dioxide and some other compounds produced during disturbance of metabolism by monoiodoacetic acid must be regarded as the result of increased excitation of nerve endings which, in these conditions, rapidly pass into a state of inhibition.

On this basis, it may be postulated that the pressor-depressor and depressor reflexes which we observed were evidence of the increased excitation of the chemoreceptors of the intestine in response to the action of toxic ascarid products.

The disturbance of chemoreception shown to occur as a result of the action of toxic products of ascarides may possibly be of importance in the pathogenesis of the toxic manifestations of ascariasis.

SUMMARY

Acute experiments were performed on cats. After the chemoceptors of the intestinal loop (isolated from the general circulation) were acted upon by water-ascaris extract, acid and alkaline compounds caused changes in circulatory and respiratory reflexes. Instead of the usual rise of arterial pressure and respiratory excitation; pressor-depressor or only depressor reflexes and, often, respiratory inhibition were noted. Thus, the mechanism of chemoception of acid and alkaline compounds is disturbed under the effect of toxic ascaris products.

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